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Not All Greenness Is the Same: Associations with Health Are More Nuanced than We Thought

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A growing body of evidence indicates that exposure to urban greenspaces, especially treed areas, benefits the health of city dwellers.[1–4] Now, new research in *Environmental Health Perspectives* finds that when it comes to those benefits, not all trees are the same.[5] Investigators at Katholieke Universiteit (KU) Leuven, Belgium, and Sciensano (the Belgian Institute of Health) assessed people's exposures to urban greenspace in relation to sales of medications for cardiovascular disease and mood disorders. The presence of larger trees was associated with lower overall medication sales, suggesting these trees "are more beneficial with respect to heart disease and mental health than smaller trees," says co–first author Dengkai Chi, a PhD candidate in bioscience engineering at KU Leuven.

Prior studies relating urban greenspace to health have generally relied on two-dimensional (2D) remote sensing, which depicts tree canopy cover but not the features of individual trees, such as the size of their crowns (the leaf-sprouting branches).[6,7] That reliance limited the ability of those studies to characterize human exposures to trees.

To improve upon the exposure assessment, Chi et al. used 3D remote sensing data generated by airborne light detection and ranging (LiDAR) systems.[5] LiDAR reliably distinguishes trees from other types of vegetation,[8] and Chi's team used it to measure arboreal traits, such as the number of trees per hectare (also known as stem density), tree height, and crown volume. The researchers focused on 604 census tracts in Brussels and surrounding areas. Tracts had an average of 11,616 inhabitants per hectare.

Medication sales data for the census tracts were obtained from the Belgian social security agency, which manages health insurance reimbursements for most of the country's population. The team limited its analysis to medications purchased by adults who were 19–64 years of age between 2006 and 2014.

The team then modeled relationships between medication sales and tree traits in single- and two-factor models. They used single-factor models to evaluate the relationship between medication sales and individual tree traits—namely, stem density or crown volume. Using two-factor models, the team evaluated how sales varied in relation to tree density, crown volume, and other traits collectively.

After adjusting for socioeconomic status (which also is associated with sales of drugs for heart disease[9] and mood disorders[10]), the researchers observed a curious result. The single-factor models showed that each unit increase in stem density and crown volume corresponded to lower medication sales. However, the two-factor model that included both stem density and crown volume showed that medication sales were, again, lower in areas with greater crown volumes but higher with greater stem densities.

The authors of the new study used airborne LiDAR to distinguish trees from grass, shrubs, and other vegetation, and to characterize both canopy size and density of trees. Images, left to right: © GrB/stock.adobe.com; © Brian Scantlebury/stock.adobe.com.

What might explain the discrepancy? According to Chi, the results demonstrate that large trees are associated with greater health benefits than even dense stands of smaller trees. "Large trees are more effective at reducing environmental stressors like urban heat, air pollution, and noise than smaller trees," she says. "That makes them very important for health in urban areas."

Matilda van den Bosch, a physician with a doctorate in landscape planning currently working at the Barcelona Institute for Global Health, says medication sales are a valid proxy for disease prevalence in the population. "This is an important paper that makes the case for preserving large trees in cities," says van den Bosch, who was not involved in the study. "Humans evolved in the natural environment, and we know that exposure to nature can activate the parasympathetic nervous system in ways that facilitate recovery from stress."[11–14]

Cecil Konijnendijk, a professor of urban forestry at the University of British Columbia and visiting professor at KU Leuven, agrees. "We need to be more tree-inclusive in terms of how we design and manage our cities," says Konijnendijk, who also was not involved in the study. "People talk about large-scale planting, but we need to start by protecting what we have. This paper helps to provides the evidence for why we should do this."

Konijnendijk and van den Bosch both say there is a need to replicate the current findings with additional research using individual-level data. In future studies, Chi says she will use airborne LiDAR and hyperspectral images to quantify other arboreal traits, such as tree species diversity, in relation to human health. "We want to really explore the potential of using this kind of 3D high-resolution sensing data in our research," she says.

Raf Aerts, co–first author of the study, adds, "Ideally, we would also like to move from aggregated census-tract level data to longitudinal individual health and exposure data. A national, European, or global tree exposure cohort would be ideal to study health effects of trees in more detail."

What do such findings mean for people who live in places where green things cannot grow? Despite a dearth of relevant research in arid or polar regions, there is evidence that greenspaces introduced into such areas may have positive effects.[15,16] "Several cultures have indeed adapted to nongreen habitats," says Aerts. "However, from an evolutionary point of view, humans are a species of tropical and subtropical forest and savanna habitats. So there is an intrinsic link between humans and greenspace."

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